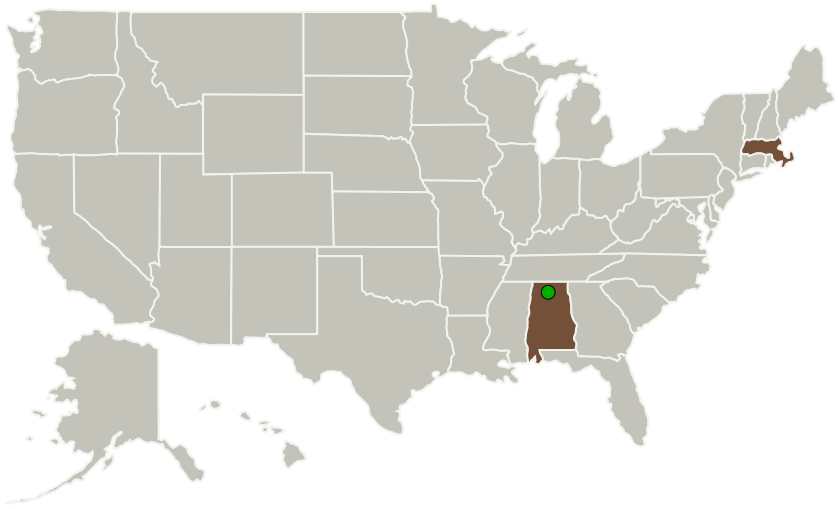
InTILF Method for Analysis of Polished Mirror Surfaces, Phase I

Completed Technology Project (2015 - 2015)

Project Introduction

Numerical simulation of the performance of new x-ray mirror performed by NASA and those under upgrade requires sophisticated and reliable information about the expected surface slope and height distributions of prospective x-ray optics before the optics are fabricated. Ideally, such information has to be based on the metrology data obtained from existing optics fabricated by the same vendor and technology, but, generally, with different sizes and slope and height rms variations. It has been demonstrated that an optical surface can be thought of as a stationary uniform random process. It was further shown that an autoregressive moving average (ARMA) modeling of one-dimensional (1D) slope measurements allows highly confident fitting of the metrology x-ray mirrors data with a limited number of parameters. With the parameters of the ARMA model, the surface slope profile of an optic with the newly desired specification can be forecast reliably. However, ARMA models are causal and do not allow for generalization from one dimension to two. We propose to generalize the method from processing of one dimensional profile data to two dimensional surface data with invertible time-invariant linear filter (InTILF). This approach will also allow to parameterize surface metrology of high quality x-ray optics optimally. Our preliminary studies indicate that the InTILF approximation has all advantages of one-sided AR and ARMA modeling, but it additionally gains in terms of fewer filter parameters and better spectral accuracy. The envisioned software can also be used to analyze a polishing process and as a feedback for polishing tools.

Primary U.S. Work Locations and Key Partners



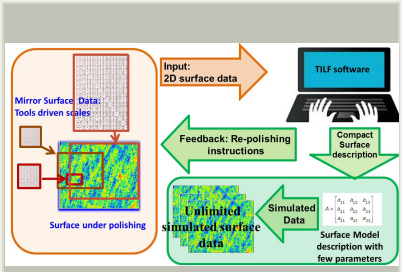


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Table of Contents

Small Business Innovation Research/Small Business Tech Transfer

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Organizations Performing Work	Role	Type	Location
Second Star Algonumerix	Lead Organization	Industry	Needham, Massachusetts
Marshall Space Flight Center(MSFC)	Supporting Organization	NASA Center	Huntsville, Alabama

Primary U.S. Work Locations	
Alabama	Massachusetts

Project Transitions

June 2015: Project Start

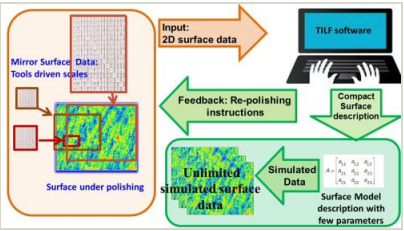
December 2015: Closed out

Closeout Summary: InTILF Method for Analysis of Polished Mirror Surfaces, Phase I Project Image

Closeout Documentation:

- Final Summary Chart Image*(https://techport.nasa.gov/file/139135)*

Images



Briefing Chart Image
InTILF Method for Analysis of Polished Mirror Surfaces, Phase I *(https://techport.nasa.gov/image/127911)*

Organizational Responsibility

Responsible Mission Directorate:
Space Technology Mission Directorate (STMD)

Lead Organization:
Second Star Algonumerix

Responsible Program:
Small Business Innovation Research/Small Business Tech Transfer

Project Management

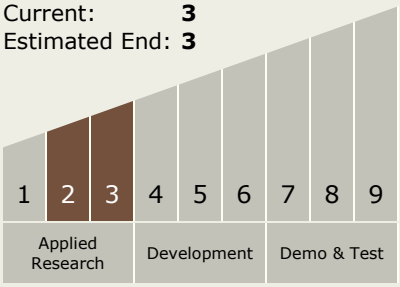
Program Director:
Jason L Kessler

Program Manager:
Carlos Torrez

Principal Investigator:
Anastasia Tyurina

Technology Maturity (TRL)

Start: **2**
Current: **3**
Estimated End: **3**



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Technology Areas

Primary:

- TX08 Sensors and Instruments
  - TX08.2 Observatories
    - TX08.2.1 Mirror Systems

Target Destinations

The Sun, Earth, The Moon, Mars, Others Inside the Solar System, Outside the Solar System